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Before the
FEDERAL COMMUNICATIONS COMMISSION
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JAN 25 1994

FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF SECRETARY

In the Matter of

Guidelines for Evaluating the
Environmental Effects of
Radiofrequency Radiation

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ET Docket 93-62

COMMENTS OF THE ELECTROMAGNETIC ENERGY POLICY ALLIANCE

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January 25, 1994

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EXECUTIVE SUMMARY

EEPA supports the Commission's proposal to modify its rules that are now based on the ANSI C95.1-1982 standard [1]. EEPA supports the use of ANSI/IEEE C95.1-1992 [2] as the appropriate standard for the following reasons:

- It is based on the most recent review of the scientific literature;
- EEPA believes that the large and diverse membership of the IEEE committee [3] reflects a more accurate consensus of the scientific community compared with smaller panels of selected experts such as Scientific Committee 53 of the National Council on Radiation Protection and Measurements (NCRP) [4], and the International Non-Ionizing Radiation Protection Committee of the International Radiation Protection Association (IRPA/INIRC) [5] (now the International Commission on Non-Ionizing Radiation Protection - ICNIRP);
- The ANSI/IEEE C95.1-1992 standard and the companion ANSI/IEEE C95.3-1992 measurement standard [6] go well beyond other recommendations and guidelines in addressing the practical problem of implementation.
- In adopting a revised RF radiation regulatory scheme, EEPA urges the commission to adopt a rational interpretation of the "controlled" and "uncontrolled" environment provisions of the revised ANSI/IEEE standard and to incorporate reasonable and practical approaches to the regulation of human exposure to "contact" and "induced" currents.
- Consistent with the approach taken in 1985, the Commission should adopt a "three-pronged" approach for broadcasters and others needing to certify compliance.

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COMMENTS OF THE ELECTROMAGNETIC ENERGY POLICY ALLIANCE

The Electromagnetic Energy Policy Alliance (EEPA) respectfully submits the following comments in response to questions raised by the Commission's Notice of Proposed Rulemaking (Notice) in this proceeding. The Notice seeks information and views to assist the Commission in their proposal to update the guidelines and methods used for evaluating the environmental effects of radiofrequency (RF) radiation.

1. **Summary.** EEPA supports the Commission's proposal to modify its rules that are now based on the ANSI C95.1-1982 standard [1]. EEPA supports the use of ANSI/IEEE C95.1-1992 [2] as the appropriate standard for the following reasons:

- It is based on the most recent review of the scientific literature;
- EEPA believes that the large and diverse membership of the IEEE committee [3] reflects a more accurate consensus of the scientific community compared with smaller panels of selected experts such as Scientific Committee 53 of the National Council on Radiation Protection and Measurements (NCRP) [4], and the International Non-Ionizing Radiation Protection Committee of the International

Radiation Protection Association (IRPA/INIRC) [5] (now the International Commission on Non-Ionizing Radiation Protection - ICNIRP);

- The ANSI/IEEE C95.1-1992 standard and the companion ANSI/IEEE C95.3-1992 measurement standard [6] go well beyond other recommendations and guidelines in addressing the practical problem of implementation.

2. **"Controlled" and "uncontrolled" environment.** EEPA believes that the definitions of controlled and uncontrolled environment in the ANSI/IEEE C95.1-1992 standard are clear. EEPA agrees with the intent of the Commission to apply the guidelines for the uncontrolled environment to any transmitters and facilities that are located in residential areas or locations with unrestricted access. EEPA also agrees that the guidelines for the uncontrolled environment should apply to the non-user of hand-held devices and to the user unless he/she is aware of the potential for the exposure as a concomitant of employment. If the use of a hand-held device is not a concomitant of employment but the user is aware of the potential for exposure through education and training (including warning labels and safety information provided in user instructions), EEPA believes that exposure of the user should be also considered in the controlled environment and the guidelines for exposure in the controlled environment should apply. Examples of the latter are hand-held transceivers for VHF marine radio service and transceivers used for amateur radio.

EEPA also agrees that the guidelines for the controlled environment should apply to other situations and radio services where exposure is incidental and transitory or the exposure is incurred in areas where personnel are aware of the exposure potential through warning signs and instructions. An example of the latter would be a land-mobile

service base-station antenna located on the roof of a public building with appropriate and adequate warning signs present.

3. **Low-Power Device Exclusion.** The ANSI/IEEE C95.1-1992 standard excludes low-power devices from the guidelines provided they meet specified requirements on radiated power (4.2.1.1 - controlled environments, and 4.2.2.1 - uncontrolled environment). The low-power device exclusion does not apply to devices operating at frequencies above 1.5 GHz or to devices with the radiating structure maintained within 2.5 cm of the body.

EEPA agrees with the Commission that certain hand-held low-power devices, such as cordless telephones and hand-held cellular phones, must comply with exclusions for the uncontrolled environment. EEPA also agrees that devices that do not comply because of radiated power, operating frequency (greater than 1.5 GHz) or because portions of the radiating structure are closer than 2.5 cm from the body during normal use, must comply with the general exclusion of the ANSI/IEEE C95.1-1992 standard for the uncontrolled environment (4.2.2), i.e., "...the [maximum permissible exposure] MPE in uncontrolled environments for the electromagnetic field strengths may be exceeded if:

(a) The exposure conditions can be shown by appropriate techniques to produce [specific absorption rates] SARs below 0.08 W/kg, as averaged over the whole body, and spatial peak SAR values not exceeding 1.6 W/kg as averaged over any 1 g of tissue (defined as a tissue volume in the shape of a cube)..."

EEPA also notes that certain other hand-held portable radios such as typically used in the Part 90 Services are appropriately included in the controlled environment because the user is aware of the potential for RF exposure. Arguments supporting this comment

are elaborated in the Telecommunications Industry Association (TIA) comments submitted to the FCC on this NPRM, and EEPA shares TIA's position on this issue.

EEPA agrees that any hand-held device that does not meet the criteria of the low-power device exclusion, because of radiated power, operating frequency or proximity of the radiating structure to the body, must be characterized by measurement or by appropriate analytical techniques to demonstrate evidence of compliance with the general exclusion of the ANSI/IEEE C95.1-1992 standard. EEPA believes that limiting demonstrability to laboratory measurements, e.g., thermography, internal electric field strength measurements or temperature measurements in an anatomically correct model, will impede further development and generally limit the acceptance of high resolution numerical techniques as an appropriate means for determining SAR distributions. EEPA believes that recent progress in numerical techniques [7] has led to methodology for determining SAR distributions that may be more useful than the laboratory measurement techniques now commonly used and in many cases is more convenient.

For the purposes above, EEPA asks the Commission to recognize alternative methods for spatial-peak SAR averaging for actual situations where the precise definition in ANSI/IEEE C95.1-1992 cannot be met. For example, there is evidence from high-resolution numerical techniques to indicate that peak SARs from some hand-held cellular devices, and hand-held devices operating at higher frequencies, occur in portions of the outer ear where "...1 g of tissue (defined as a tissue volume in the shape of a cube)... can not be defined. That is, because of curvature or tissue thickness any cubic volume centered at the location where the spatial peak SAR occurs also contains air. The Interpretation Working Group of Subcommittee-4, IEEE Standards Coordinating Committee 28 has been asked to address this issue [8]. EEPA asks the

Commission to consider as an alternative to the existing definition, any forthcoming interpretation addressing this issue.

EEPA recommends that proof of compliance be submitted as part of the equipment authorization process rather than the licensing process. The showing of proof should be an affirmative statement of compliance based on either actual SAR measurements made in an anatomically correct model or appropriate numerical analyses.

EEPA believes that a de minimis power level exists for certain devices below which the appropriate SAR exclusions will always be met regardless of separation distance and frequency. Once this value becomes known to the FCC, the Chief Engineer should have the option of categorically excluding lower power devices from the paperwork requirements and from testing requirements.

4. **Existing Categorical Exclusions.** EEPA is limiting its comments to cellular radio and point-to-point microwave radio. EEPA believes that these services should remain categorically excluded from the NEPA requirement for routine evaluation for the following reasons:

a) **Microwave point-to-point radio:** The ANSI/IEEE C95.1-1992 electromagnetic field guidelines for the uncontrolled environment are one-fifth of the ANSI C95.1-1982 guidelines for frequencies between 300 and 1500 MHz, and then increase with frequency until they are equal to the 1982 guidelines at 7.5 GHz and exceed the 1982 guidelines for frequencies greater than 7.5 GHz.

The low power used for point-to-point microwave radio and the general inaccessibility of the main beam of the antenna pattern result in potential exposure levels in the general

environment that are far below the ANSI/IEEE C95.1-1992 limits for the uncontrolled environment. The results of field-strength measurements made in normally accessible areas (uncontrolled environment) have shown that the potential exposure of the public from typical antenna configurations used for point-to-point microwave radio is at levels significantly below 1 uW/cm² [9,10]. Therefore, the ANSI/IEEE C95.1-1992 guidelines for the uncontrolled environment will not impact on this service. The ANSI/IEEE C95.1-1992 guidelines for the controlled environment are the same, or higher (frequencies greater than 1.5 GHz), than the ANSI C95.1-1982 limits and likewise will not have any impact; EEPA, therefore recommends that the Commission retain the categorical exclusion for all microwave point-to-point services.

b) **Land-mobile (cellular) - base stations:** The ANSI/IEEE C95.1-1992 guidelines for the uncontrolled environment are one-fifth of the 1982 ANSI C95.1-1982 limits for the 800-900 MHz frequency band. The results of field-strength measurements made in the vicinity of typical tower-mounted antennas used for cellular radio, extrapolated to represent worst-case conditions, have shown that exposure of the public is at levels below 1 uW/cm² [11].

EEPA recognizes that there could be some cellular-radio installations where members of the public could have limited access and the potential exposure levels could exceed the guidelines for the uncontrolled environment, e.g., directly in front of a sector antenna with several 100 W ERP channels continually transmitting. However, the presence of people at such locations is likely to be transient. EEPA believes that the proper way to handle these rare cases is through warning signs and barriers, thereby creating a controlled environment.

Although the ANSI C95.2-1982 guidelines are the same as the ANSI/IEEE C95.1-1992 guidelines for the controlled environment, there may be rare situations where exposure of the worker may exceed these guidelines. However, since the 1982 guidelines now used by the FCC are identical to the 1992 guidelines for the controlled environment, EEPA believes that the rationale for excluding cellular radio in 1987 is still valid. Moreover, evolutionary development of the cellular system infrastructure, which results in smaller cells (including microcells) and lower transmitter power, will reduce further any potential exposure of the public and the worker. Since services that are categorically excluded from routine environmental assessment must still comply with the 1992 ANSI/IEEE limits, EEPA believes that the proper way to handle those few sites that may not comply is by means of worker training and work practices to limit exposure.

Therefore, EEPA believes that the impact of the ANSI/IEEE C95.1-1992 standard on cellular-radio is minimal and the categorical exclusion for these services should be retained. However, it is reasonable for the Commission to require certification that work practices and policies of posting warning signs are in place, on a case-by-case basis for those few situations where the 1992 ANSI/IEEE guidelines may be exceeded.

c) **Mobile cellular-radios:** Exposure of the non-user to mobile cellular-radios, when time averaged over the 30 minute averaging time specified for the uncontrolled environment in the ANSI/IEEE C95.1-1992 standard, will essentially be at levels far below the corresponding guidelines. A dosimetry study carried out at the University of Washington [12] examined a number of exposure situations including an adult and a child leaning over a vehicle roof approximately 40 cm from a roof-mount transmitting antenna, an adult in the rear seat of a car in proximity to a deck-mount antenna, a child kneeling in the rear seat in proximity to a deck-mount antenna, and an adult woman standing with her abdomen approximately 9 cm from a deck mount antenna. The

results of this study indicated that even under worst-case exposure conditions (the women 9 cm from the deck-mount antenna), spatial-peak SARs of 1.6 W/kg or less (the spatial peak SAR requirements for the uncontrolled environment) could be expected if the radiated power (not ERP) is below 7W. Time-averaging to correspond to practical exposure situations would further reduce this value considerably. EEPA believes that the University of Washington study provides sufficient evidence to indicate that typical user and non-user exposure from vehicle-mounted cellular antennas is well below the guidelines of ANSI/IEEE C95.1-1992 and these units should remain categorically excluded.

5. **Alternative RF Exposure Guidelines.** EEPA supports the Commission's proposal to use the ANSI/IEEE C95.1-1992 standard as a basis for modifying its rules. EEPA believes that ANSI/IEEE C95.1-1992 is appropriate in that: 1) It is based on a more recent review of the scientific literature than the NCRP Report; 2) It is consistent with the most recent proposal (for the controlled environment) of the American Conference of Governmental Industrial Hygienists; 3) The large and diverse membership of Subcommittee-4 represents a more accurate consensus of the scientific community than do the small panels of selected experts such as Scientific Committee 53 of NCRP and the IRPA/ICNIRP committee; 4) ANSI/IEEE C95.1-1992 and the companion standard ANSI/IEEE C95.3-1992 go well beyond any other standard in addressing the major issue of implementation.

EEPA supports the 10 mW/cm² ANSI/IEEE C95.1-1992 MPE because for frequencies where the depth of penetration is similar to that for infrared radiation (frequencies of the order of 15 GHz and greater) and, hence, where the biological effects would be expected to be similar, the C95.1-1992 MPE is consistent with well-established biologically based national [13] and international [14] limits for infrared lasers. At 300

GHz the ANSI C95.1-1993 MPE, the MPE in the ANSI Z136.1-1993 [13] and the MPE in the IEC [14] laser standard are all equal. (Three hundred GHz is the upper frequency limit of the C95.1 standard and the lower frequency limit of the laser standards.) Moreover, the 10 second averaging time is the same for all three standards. The 6 min averaging time found in the NCRP and IRPA document is not sufficiently short to protect against skin burn for exposure to short pulses (of the order of one-half second) at frequencies above a few 10's of GHz where most of the energy is deposited in thin surface layers of tissue.

With regard to special provisions with respect to amplitude modulated carrier frequencies, as found in Report 86 of the NCRP, EEPA believes that the experimental work, e.g., calcium efflux from freshly excised chick and cat brain tissue [15, 16, 17, 18], that led to these provisions is controversial and has not been convincingly replicated. Frequency, amplitude, temperature, static magnetic field and time "windows" associated with these studies, and the inability to relate their results to human health, preclude these studies from being useful for standards development. This issue has been considered in the process that led to the 1992 ANSI/IEEE limits. EEPA agrees with the statement in the ANSI/IEEE C95.1-1992 rationale. "The members of Subcommittee-4 believe the recommended exposure levels should be safe for all, and submit as support for this conclusion the observation that no reliable scientific data exist indicating that:...(4) Nonthermal (other than shock) or modulation-specific sequelae of exposure may be meaningfully related to human health."

In further support of our position regarding amplitude modulated RF fields, no other organization that has recently developed exposure criteria, including IRPA/ICNIRP [19], the National Radiological Protection Board in the UK [19], the VDE in Germany [21], the American Conference of Governmental Industrial Hygienists (ACGIH) [21], Commission

5 of the European Communities [23] has considered this to be a meaningful issue. EEPA therefore recommends that the Commission not consider modifications to the limits for the controlled environment for exposure fields that are amplitude modulated at frequencies below 100 Hz.

Among those participating today, in addition to EEPA in the instant proceeding is an EEPA member, the National Association of Broadcasters ("NAB"), which, on behalf of its members, offers its support as well as numerous recommendations for the FCC's implementation of the revised guidelines. EEPA is also aware that CBS Inc. along with other broadcasters are filing joint comments in this proceeding. The broadcasting industry ("Broadcasters") supports, in general, the Federal Communications Commission's proposal [24] for evaluating the environmental effect of human exposure to "nonionizing electromagnetic energy," or "RF radiation." EEPA's comments herein reflect the general concerns of Broadcasters and we urge the Commission to consider carefully the comments filed by NAB and CBS et al.

Broadcasters believe that ANSI/IEEE C95.1-1992 reflects much more current thinking, theory and scientific findings than the body of knowledge upon which the 1982 ANSI/IEEE standard was based. Broadcasters find the revised ANSI/IEEE standard to be far preferable to other possible substitutes, discussed in the Notice. On the other hand, the Commission has a responsibility to "interpret" the revised ANSI standard in a fashion that will meet the Commission's obligations under NEPA yet not impose undue and unjustified burdens on broadcast licensees or other communications operations to be regulated under this revised regime.

Of special focus in this regard are the ANSI/IEEE C95.1-1992 treatment of "induced current" and "contact current" exposures. For the reasons stated below, on these

matters in particular the Commission must adopt a regulatory approach which is faithful to the standard but recognizes -- and gives deference to -- several practical problems with the assessment of compliance. The achievement of such a regulatory balance is particularly important in complicated situations involving "joint use" sites where many emitters are located in close proximity to each other.

Consistent with the approach taken in 1985, the Commission should adopt a "three-pronged" approach for broadcasters and others needing to certify compliance. Under this approach, the FCC would adopt, and incorporate in its revised Technical Bulletin, charts and graphs that could be employed to easily determine, in the majority of situations, compliance with the FCC's RF exposure guidelines. Where compliance, using these charts and graphs, cannot readily be confirmed, then the Commission should allow its regulatees to employ mathematical formulas to determine compliance. Only when compliance cannot be determined by using the above-mentioned techniques would a broadcaster or their parties subject to the revised rules be required to conduct actual measurements. We urge that this three-pronged approach, as well as other aspects of determining compliance, be addressed once again in a "Technical Bulletin."

In furtherance of this philosophy, NAB commissioned Jules Cohen, P.E. to develop a draft for such a revised technical bulletin. [26] This proposed revision of QSST Bulletin No. 65 is offered as a starting point for the forthcoming government/industry discussions which, ultimately, will be used by broadcasters and others to determine compliance with the revised FCC RF guidelines. Embodied in the draft bulletin is the application of the three pronged approach to the issue of induced RF currents. While additional research may be necessary to obtain more "real world" data, the worst case data used by Mr. Cohen resulted in the development of charts and graphs that can be used to

demonstrate compliance with the ANSI/IEEE RF current limits without resorting, at least initially, to costly field measurements.

In adopting a revised RF radiation regulatory scheme, Broadcasters urge the Commission to adopt a rational interpretation of the "controlled" and "uncontrolled" environment provisions of the revised ANSI standard and to recognize that, in general, most broadcast related operations can be categorized as controlled environments. Further, the Commission should incorporate reasonable and practical approaches to the regulation of human exposure to "contact" and "induced" currents. The FCC must adopt definitive compliance methods as well as develop, in cooperation with industry, accurate, repeatable and uniform measurement techniques that broadcasters and others can use to evaluate their facilities.

Key in the consideration of these issues is the concept of transient passage or transient exposure. Simply put, the concept of transient exposure as discussed in the ANSI/IEEE standard [27] asserts that it is safe for people to be exposed on a short duration, non-recurring basis to RF radiation in excess of the uncontrolled environment levels, so long as the controlled environment standard is not exceeded. Transient exposure accommodates the practical realities of regulating RF exposure especially with respect to induced RF currents. Broadcasters urge the Commission to explore fully and establish an effective way of applying transient exposure in the development of a revised OST Bulletin No. 65.

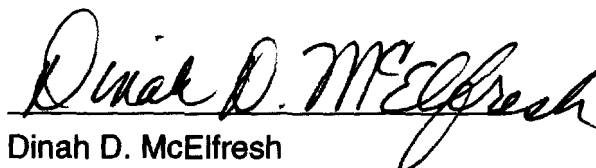
Broadcasters also believe that the Commission responsibly can continue a program of "categorically excluding" various communications operations from the FCC's RF regulatory program. Further, the FCC should adopt a policy of allowing the use of glove

and other protective clothing in assuring compliance with its newly revised RF guidelines.

The above issues as well as many other issues are discussed fully in the comments of NAB, CBS, et al, and others in the broadcasting industry. EEPA urges the Commission to consider carefully the submissions of Broadcasters in this proceeding. Broadcasters together with EEPA pledge their assistance in the development of a new OST Bulletin No. 65 and in implementing FCC's revised RF guidelines in such a way as to meet the Commission's obligations under NEPA yet not impose undue and unjustified burdens on broadcast licensees or other communications operations to be regulated under this revised regime.

Respectfully submitted,

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- [1] American National Standard Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 300 kHz to 100 GHz, ANSI C95.1-1982, American National Standards Institute, New York, NY.
- [2] IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz, Institute of Electrical and Electronics Engineers, New York, NY.
- [3] Subcommittee-4 had a membership of 120 at the time the standard was approved and additional non-members were involved in the literature evaluation process. Scientific Committee 53 of the National Council on Radiation Protection and Measurements had 6 committee members, 5 advisory members and 5 consultants; IRPA/INIRC had 15 committee members.
- [4] NCRP Report No. 86, Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields, National Council on Radiation Protection and Measurements, Bethesda, MD (1986).
- [5] Guidelines on Limits of Exposure to Radiofrequency Electromagnetic Fields in the Frequency range from 100 kHz to 300 GHz, in IRPA Guidelines on Protection Against Non-Ionizing Radiation; Duchene, A.S., Lakey, J.R.A. and Repacholi, M.H. Eds.; Pergamon Press, New York (1991).
- [6] IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields -- RF and Microwave, ANSI/IEEE C95.3-1992, Institute of Electrical and Electronics Engineers, New York (1992).
- [7] A finer resolution eleven tissue model of the human head and neck has been developed from MRI scans of a male volunteer at the University of Utah. The model of the head, neck, phone and the interaction space between the head and phone is divided into approximately 2.5 million cells approximately 2 mm by 2 mm by 2.5 mm. The MRI scans were taken with a resolution of 3 mm along the height of the body and 1.9 mm for the orthogonal axes in the cross-sectional planes. The finite-difference time-domain (FDTD) technique is being used with this model by Dr. O.P. Gandhi to characterize the

SAR distributions from a number hand-held phones at cellular frequencies and also at higher frequencies. The agreement with the corresponding results is excellent.

- [8] Agreed on at the June 12, 1993 meeting of SC-4, IEEE SSC28, Biltmore Hotel, Los Angeles, CA.
- [9] Petersen, R.C. and Testagrossa, P.A., "Radio-Frequency Electromagnetic Fields Associated with Cellular-Radio Cell-Site Antennas," Bioelectromagnetics, Vol. 13, No. 6 (1992).
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- [11] Petersen, R.C., "Electromagnetic Radiation from Selected Telecommunications Systems," Proceedings of the IEEE, Vol. 68, No. 1 (1980).
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- [13] American National Standard for the Safe Use of Lasers, ANSI Z136.1-1993, American National Standards Institute, New York, NY (1993).
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- [17] Blackman, C.F., Kinney, L.S. and Joines, W.T., "Multiple Power-Density Windows and their Possible Origin," Bioelectromagnetics, Vol. 10, No. 2, pp. 115-128 (1989).
- [18] Blackman, C.F., Benane, S.G. and House, D.E., "The Influence of Temperature During Electric- and Magnetic-Field-Induced Alteration of Calcium-Ion Release from In-Vitro Brain Tissue," Bioelectromagnetics, Vol. 12, No. 3, pp. 173-182 (1991).
- [19] Electromagnetic Fields (300 Hz to 300 GHz), "Environmental Health Criteria; 137, International Radiation Protection Association/World Health Organization, Geneva, (1993).
- [20] NRPB
- [21] Safety in Electromagnetic Fields; Protection of Persons in the Frequency Range from 30 kHz to 300 GHz, Deutsche Norm, DIN, VDE 0848 (October, 1991 Draft).
- [22] Annual Report of the Committees on Threshold Limit Values and Biological Exposure Indices, American Conference of Governmental Industrial Hygienists, Cincinnati, OH (1993).
- [23] "Proposal for a Council Directive on the Minimum Health and Safety Requirements Regarding the Exposure of Workers to the Risk Arising from Physical Agents," Official Journal of the European Communities, No. C77, pp. 12-29 (March 18, 1993).
- [24] Notice of Proposed Rule Making ("Notices") in ET Docket No. 93-62, 8 FCC Rcd 2849 (1993).
- [25] See Section 1.11307 (b) of the Commission's Rules, 47 C.F. R. §1.1307 (b). Also key to the Commission's current regulatory scheme for controlling RF radiation exposure is FCC OST Bulletin No. 65, prepared by Dr. Robert F. Cleveland, FCC Office of Engineering and Technology (previously the FCC Office of Science and Technology). OST Bulletin No. 65 also contains the work product of other government representatives and was influenced by the comments and suggestions of various individuals and organizations acknowledged in the Bulletin.

[26] This proposed bulletin is attached to the comments of the National association of Broadcasters as Appendix I.

[27] See ANSI/IEEE standard, §2 and §6.

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